Interim Progress Report On Energy Storage For Colorado Department Of Agriculture

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Intent of the Project

As energy becomes increasingly expensive, the public interest in renewable energy continues to expand. Agricultural producers can directly benefit with the installation of these renewable technologies, but a serious problem exists in the storage of this available energy. Many energy producers are forced to gain credits for their energy only to deplete their credits and rely on the utility's grid or they build larger systems than 25kW and cannot tie these systems into the grid to gain credits when renewable energy is not available. This offsets the economic benefits of operating a large renewable energy system and forces producers to rely on the ever increasing prices of the utilities.

Completed Progress on Project

A large project document was created by researching all energy storage technologies for a utility scale energy storage system. The Colorado School of Mines Epics Program formulated the report summarizing the most viable energy storage devices that could be implemented in rural applications of renewable energy. Each storage device was analyzed for economic viability, efficiency, life span of the system, storage capacity and duration, size, and the needs of the rural consumer. The students were supplied with over thirty research documents from iCAST on energy storage with the task of creating a decision matrix to compare each technology. Based on the decision matrix, five energy storage technologies were selected for storing excess energy produced by renewable energy systems. Twenty different energy storage devices were considered in the decision matrix and five were recommended by the students after researching all possibilities. The team expanded on each disadvantage and advantage of each storage device considering a more detailed version of the decision matrix criteria for each device.

iCAST formulated another decision matrix involving the five suggested energy storage technologies and has narrowed our focus down to three main strategies: hydrogen fuel cell, lithium ion batteries, and supercapacitors.

- Hydrogen Fuel Cells

Probably the most famous energy storage technology, hydrogen fuel cells are flow batteries that use hydrogen and oxygen as its electrolyte solution. These gases are compressed and stored after being separated from water using electrolysis. After running these products across a proton

exchange membrane, the water is reformed. Its method of storing energy occurs when the solution is electrolyzed again.

- Lithium Ion Batteries

Lithium Ion batteries have a higher energy density than many of the other energy storage technologies. This leads to a very high number of recharge/discharge cycles throughout their lifetime and can also retain their capacity over their lifetime. Finally, their popularity means their energy storage capabilities have been tested in several different applications.

- Supercapacitors

Supercapacitors are a relatively new technology and beginning to replace batteries in a variety of applications varying from powering backup energy storage systems to handheld devices such as flashlights and radios. One exception quality of this technology is their charging and discharging rates. Supercapacitors, unlike Lithium Ion batteries and hydrogen fuel cells, do not store energy as chemical energy but instead use the potential difference between two parallel plates sometimes with a dielectric placed between them.

This matrix was created for the senior design team at the University of Colorado-Boulder senior design project. By the end of the day on September 9, 2008, iCAST will have all the teams' applications for the project and will choose one to take over the project. These students will only have a certain amount of time to design and build the storage device; therefore, we have narrowed down their research to these three options. The student team will design the pilot storage device in the fall semester and will build and test the device in the spring semester. The device will be tested at the university's wind lab before the final recommendations of the students are presented to iCAST.

Drafts of the implementation proposal and research proposal to the Colorado Department of Agriculture are completed and will be ready for submission on September 17, 2008. Several hours of research went into each proposal and a number of industry professionals were contacted to add validity to our research. iCAST has established a firm schedule to adhere to the timelines of this project and has thoroughly explained the potential impact of the research to the students in our description of the project.